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**EPIDEMIOLOGIC STUDIES IN
ELITE WARFIGHTERS: U.S. AIR
FORCE BATTLEFIELD AIRMEN,
ARMY RANGERS, AND NAVY
SEALS**



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1.0 INTRODUCTION

U.S. Air Force battlefield airmen are a select group of warfighters consisting of personnel in the following career fields: combat controllers (ground troops), pararescue (air recovery and medical treatment), tactical air control party (liaison between air and ground operations), special operations weather (meteorological intelligence), and explosive ordnance disposal (bomb disablers). U.S. Army Rangers and U.S. Navy Sea, Air, and Land (SEALs) are generally considered counterparts to battlefield airmen. Although little epidemiologic research has been conducted on battlefield airmen and battlefield airmen trainees, some has been done on Rangers, SEALs, and their trainees. This paper summarizes some of the available literature.

All of these warfighters are akin to elite athletes. Therefore, their physical and mental health is critical to successful performance and overall military mission success. However, due to the specialized nature of their work, they experience stressors not often experienced by other career fields. These stressors can include sleep deprivation, caloric restriction, terrain and climate challenges, excessive physical activity, life-threatening situations, and graphic war violence.

2.0 FACTORS FOR PERFORMANCE OPTIMIZATION

2.1 Cognitive Functioning

It is not surprising that cognitive functioning is impaired during stressful situations; however, much of the evidence in these populations is anecdotal. One group conducted a series of analyses to characterize the impairment. During a stressful combat-like training exercise, cognitive function was found to be impaired at a level greater than typically seen produced by alcohol intoxication or clinical hypoglycemia (Ref 1,2). The effect of caffeine on cognitive functioning was tested. Measurements included four cognitive tests, mood state, and marksmanship. In general, they found that although sleep deprivation [average hours of sleep per night: 3.2 (Ref 3)] and stress affected performance and mood, caffeine mitigated those effects in a dose-dependent manner. However, marksmanship was not improved with the addition of caffeine (Ref 4). The effects on marksmanship were measured by accuracy and sighting time, which were both negatively affected under sleep deprivation. Sighting time was reduced with the addition of caffeine (as compared to placebo), but accuracy was not improved (Ref 5).

Another study found that accuracy of cognitive function was not impaired under stressful conditions, but it took longer than normal for tasks to be completed (Ref 6). The authors reassessed the students 5 weeks after training to determine if long-term effects were present. Four tests were given for cognitive functioning, and three of those (decoding, pattern analysis, and reasoning) showed substantial recovery (memory did not). A third group studied the effect of fitness on fatigue and found that increased fitness may have a positive effect on cognitive performance, particularly in context of sleep loss and other stressors (Ref 7).

2.2 Immunological Functioning

In the training environment, stressors can also have effects on immunological functioning. Moore et al. (Ref 8) found that T- and B-lymphocyte proliferation was impaired and that Rangers were more susceptible to infectious diseases. Kramer (Ref 9) also found that there were reduced numbers of circulating T-lymphocytes. Substantial recovery of T-lymphocyte activity was demonstrated 5 weeks post-training (Ref 6). The authors suggest that refeeding and increases in sleep can restore immune and cognitive functioning, given enough time. They also suggest that increasing caloric intake can help improve immune function and thus fight infection. However, another group looked at the effect of a nutrient-rich food bar during stress on immune function and found no significant changes in antibody response (Ref 10). Testosterone, 3,5,3'-triiodothyronine, and insulin-like growth factor were found to be reliable biomarkers of energy deficits in the presence of stress (Ref 11).

2.3 Nutrition

During a 2004 operation in Afghanistan, nutrition was a major concern. Midla suggests that a multivitamin be added to the meals ready to eat provided to our deployed troops and that a banquet of rations prior to deployment should be stressed, in preparation for the fasting that occurs (Ref 12). This was not a research study, however, but an expert's opinion.

During Ranger training, Pleban et al. (Ref 3) found that although body mass decreased over the course of training, body fat did not. This suggests that the body mass reduction was in the form of lean body mass. However, a similar study found that body fat did decrease from approximately 15% to 5% and that immune function was suppressed (Ref 13). Intervention included a small increase (16%) in caloric intake, which resulted in decreased weight loss and improved immune function. Interestingly, a Norwegian study found that females were more likely to oxidize body fat per kilogram fat-free mass during stressful training than males (Ref 14).

2.4 Conditioning

In 1994, a Navy group designed an exercise program for SEALs to address both aerobic and anaerobic fitness needs in context of cycles of low-intensity work followed by high-intensity activity. Training time, including physical training time, needs to be used efficiently and effectively to meet operational needs. The authors designed the program to meet both aerobic and anaerobic fitness needs in the same training session, rather than separate workouts. The program consisted of three groups: continuous, intermittent, and supramaximal training. They found that their program improved both aerobic and anaerobic capacity (in all groups), which would allow for better use of training time (Ref 15). However, this study had a small number of subjects.

2.5 Health Risk Behaviors

A health assessment of Army Rangers at Fort Benning, Georgia, found that additional health education programs for this select population are recommended (Ref 16). The Rangers surveyed had high usage of tobacco and alcohol, which is concerning because of the high physical demands placed on them. However, the athletes were successful at maintaining hydration in proportion to their high levels of physical activity and were actively taking supplements to improve performance. The authors suggest that dietary recommendations for elite athletes were not being met in this population and that optimization of diet is necessary. Additionally, the high level of supplement use was concerning due to the lack of a supporting rationale. These two items, coupled with high tobacco and alcohol use, emphasize the need for education of this population, although the authors do not provide suggestions on ways to educate.

Health risk behaviors seen in Navy SEALs included high smokeless tobacco use, high alcohol use, low seat belt use, and high rates of drunk driving. However, this group had high levels of physical activity and a low smoking rate (Ref 17). Sexually transmitted disease rates were also high, suggesting risky sexual behaviors. SEAL recruits had high rates of overuse injuries, which were found to be more prevalent in those who had less physical activity before entering training (Ref 18). A Navy group suggested ways to reduce attrition by prescreening and selecting certain characteristics in trainees entering the program (Ref 19). An Army group looked at attrition as well, but in active Rangers, and found that terrain and equipment load had the largest effect on attrition (Ref 20). In 1991, Garrett (Ref 21) suggested that the components necessary for maintaining unit cohesiveness and motivation for combat lie in four factors: morale, cohesion, training, and effective leadership.

2.6 Altitude Sickness

Of those who ascend to elevations above 9,000 feet, approximately one-fifth experience altitude sickness. In a group deployed to Afghanistan, premedication for altitude sickness was performed [250 mg twice a day acetazolamide (Diamox), 24 hours before infiltration; 125 mg twice a day upon landing and continued for an additional 4 days). At the end of the operation, zero individuals experienced altitude sickness (Ref 12). However, this was not a research study but rather observations from the field.

2.7 Heat Injury

A core temperature monitoring unit was tested in a group of Ranger trainees to assess thermal strain by monitoring core temperature. Medics rated the device easy to use and indicated they were likely to use the item if provided to them (Ref 22). This would provide early detection of heat injury so that cooling interventions could be given early, thus minimizing injury severity.

3.0 SUMMARY

Cognitive functioning was impaired under stressful situations at a level greater than typically seen produced by alcohol intoxication, but caffeine appeared to mitigate the impairment in areas other than marksmanship. Not surprisingly, the stressful training environment negatively affected the immune system; however, supplementation with additional nutrients may mitigate this effect. Long-term cognitive and immunological effects were not generally present given adequate time for rest and caloric replenishment. Additional nutritional supplementation may also decrease weight loss, especially considering that weight loss may be in the form of lean body mass (as opposed to body fat). Elite warfighters appear to engage in risky health behaviors such as high tobacco and alcohol use, low seat belt use, high rates of drunk driving, and risky sexual behaviors. Education of this population in the training environment is encouraged to reduce these behaviors, as well as provide nutritional instruction. Finally, technology may be a valuable tool for early detection of adverse events in the training environment, allowing for early intervention and reduced injury and illness.

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